

**PATENT COOPERATION TREATY**  
**PCT**  
**INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY**  
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference <b>E38553 KOH/J</b>	<b>FOR FURTHER ACTION</b> See Form PCT/IPEA/416	
International application No. <b>PCT/NO2005/000040</b>	International filing date ( <i>day/month/year</i> ) <b>03-02-2005</b>	Priority date ( <i>day/month/year</i> ) <b>11-02-2004</b>

International Patent Classification (IPC) or national classification and IPC

See Supplemental Box

Applicant

**Ellycrack AS et al**

<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of <u>6</u> sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> (<i>sent to the applicant and to the International Bureau</i>) a total of <u>4</u> sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (<i>sent to the International Bureau only</i>) a total of (indicate type and number of electronic carrier(s)) _____, containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>																								
<p>4. This report contains indications relating to the following items:</p> <table> <tbody> <tr> <td><input checked="" type="checkbox"/></td> <td>Box No. I</td> <td>Basis of the report</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td>Box No. II</td> <td>Priority</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. III</td> <td>Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. IV</td> <td>Lack of unity of invention</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td>Box No. V</td> <td>Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. VI</td> <td>Certain documents cited</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. VII</td> <td>Certain defects in the international application</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. VIII</td> <td>Certain observations on the international application</td> </tr> </tbody> </table>	<input checked="" type="checkbox"/>	Box No. I	Basis of the report	<input checked="" type="checkbox"/>	Box No. II	Priority	<input type="checkbox"/>	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability	<input type="checkbox"/>	Box No. IV	Lack of unity of invention	<input checked="" type="checkbox"/>	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement	<input type="checkbox"/>	Box No. VI	Certain documents cited	<input type="checkbox"/>	Box No. VII	Certain defects in the international application	<input type="checkbox"/>	Box No. VIII	Certain observations on the international application
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Date of submission of the demand <b>06-09-2005</b>	Date of completion of this report <b>28-12-2005</b>
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. +46 8 667 72 88	Authorized officer <b>Fernando Farieta/Els</b> Telephone No. +46 8 782 25 00

**INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY**

International application No.
PCT/NO2005/000040

**Supplemental Box**

In case the space in any of the preceding boxes is not sufficient.  
Continuation of: Cover sheet

**INTERNATIONAL PATENT CLASSIFICATION (IPC) :**

**C10G 11/18 (2006.01)**

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/NO2005/000040

## Box No. I Basis of the report

1. With regard to the language, this report is based on:

the international application in the language in which it was filed

a translation of the international application into \_\_\_\_\_, which is the language of a translation furnished for the purposes of:

international search (Rules 12.3(a) and 23.1(b))

publication of the international application (Rule 12.4(a))

international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the elements of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

the international application as originally filed/furnished

the description:

pages 1-16 as originally filed/furnished

pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_

pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_

the claims:

pages \_\_\_\_\_ as originally filed/furnished

pages\* 17 - 19 as amended (together with any statement) under Article 19

pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_

pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_

the drawings:

pages 1-3 as originally filed/furnished

pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_

pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_

a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3.  The amendments have resulted in the cancellation of:

the description, pages \_\_\_\_\_

the claims, Nos. 1-12 \_\_\_\_\_

the drawings, sheets/figs \_\_\_\_\_

the sequence listing (*specify*): \_\_\_\_\_
any table(s) related to the sequence listing (*specify*): \_\_\_\_\_

4.  This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

the description, pages \_\_\_\_\_

the claims, Nos. \_\_\_\_\_

the drawings, sheets/figs \_\_\_\_\_

the sequence listing (*specify*): \_\_\_\_\_
any table(s) related to the sequence listing (*specify*): \_\_\_\_\_

\* If item 4 applies, some or all of those sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY**International application No.  
PCT/NO2005/000040**Box No. II Priority**

1.  This report has been established as if no priority had been claimed due to the failure to furnish within the prescribed time limit the requested:
  - copy of the earlier application whose priority has been claimed (Rule 66.7(a)).
  - translation of the earlier application whose priority has been claimed (Rule 66.7(b)).
2.  This report has been established as if no priority had been claimed due to the fact that the priority claim has been found invalid (Rule 64.1). Thus for the purposes of this report, the international filing date indicated above is considered to be the relevant date.
3. Additional observations, if necessary:

The priority is considered valid.

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/NO2005/000040

**Box No. V**      **Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Claims	<u>1-12</u>	YES
	Claims	_____	NO
Inventive step (IS)	Claims	<u>1-12</u>	YES
	Claims	_____	NO
Industrial applicability (IA)	Claims	<u>1-12</u>	YES
	Claims	_____	NO

**2. Citations and explanations (Rule 70.7)**

The present invention relates to upgrading of heavy oils in a riser of varying cross section under the influence of accelerating and retarding energy carriers colliding with atomized droplets of oil with undergo instant vaporization with subsequent cracking according to amended claims 1-12.

Reference is made to the following documents:

D1: WO 0047695

Document D1 comprises a catalytic cracking process, a reactor under the influence of a rotating fluidized bed catalyst and compressed gases and/or steam is injected in order to effect movement of the catalyst bed (See fig. 4).

D2: US5538623

Document D2 relates to an FCC process and apparatus operates with closed reactor cyclones and a catalyst stripper using H<sub>2</sub> or recycled stripper vapor for stripping gas (Fig. 1).

D3: US5234578

Document D3 comprises a fluidized catalytic cracking process utilizing a high temperature reactor (525 DEG C.) and directly transfers catalyst and hydrocarbons to a series of cyclone separators, the stripping of spent catalyst in a heated stripper zone for the recovery of additional hydrocarbon vapours, and the immediate quenching of a converted hydrocarbon feed upon leaving a cyclone separator raises the octane and product yield in an FCC process (Fig.1).

.../...

**Supplemental Box**

In case the space in any of the preceding boxes is not sufficient.

Continuation of: **BOX V**

D4: US5348644

Process and apparatus for contacting a hydrocarbon feedstock with hot solid particles in a tubular reactor with a rising fluidized bed is described in document D4 (Fig. 4).

**Novelty**

Document D1 differs with the claimed application in that the cracking takes place in the riser. The processes of documents D2/D3 used hydrogen as stripping gas, unlike the case in the claimed invention. Document D4 comprises a unit reactor as such a reactor and internal cyclone for the separation of the energy carriers (sand) from the waste gases.

The claimed cracking processes in amended claims 1-12 are not considered to be within the scope of protection of documents D1-D4. Thus, amended claims 1-12 are considered to fulfil the requirements of novelty.

**Inventive step**

The problem to be solved is that heavy feedstock requires to overcome:

- Feed vaporisation
- High concentration of polar molecules
- Presence of metals.

The present claimed invention solves the problem by using two regenerators, mild oxidation of catalyst and temperatures between 450-600 °C in combination with low partial pressure, atomisation nozzles and a cyclone.

In view of documents D1-D4 above, the skilled person would not achieve a cracking process by combining the features of the known cracking processes steps as set out in amended claims 1-12. Thus, the subject-matter of amended claims 1-12 are considered to involve an inventive step.

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New claims

1.

A thermodynamic cracking process, characterised in that cracking is carried out in a cyclone reactor and in a riser with varying diameter under the influence of a rotating and turbulent fluidised energy carrier in the form of fine grained minerals, whereby the particles are put in motion from the regenerator operated at a temperature of 450°C to 600°C through two exit lines with outlet under the level of the fluidized bed and are transported to the riser by combustion gases in the fluidization reactor.

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2.

The thermodynamic process in accordance with claim 1, characterised in that the energy carrier is selected from fine grained minerals, such as silica, magnesium oxide, aluminium oxide, copper oxide, anorthosite, olivine or similar materials.

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3.

The thermodynamic process in accordance with claim 1, characterised in that the reactor cyclone has an entrance which is diverting the flow of catalyst and gases whereby they will be subject to strong mechanical shear forces and where the catalyst may be evacuated from the reactor cyclone and be discharged to a regenerator via a rotating valve system and/or another closing device.

4.

The thermodynamic process in accordance with claim 1 and/or 3, characterised in that the deactivated energy carrier is regenerated in a fluidised regeneration chamber having a fluidizing perforated plate above a plenum receiving either combustion gases or air and where the energy carrier is regenerated by oxidizing co-accumulated coke contained therein.

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AMENDED SHEET (ARTICLE 19)

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5.

The thermodynamic process in accordance with claim 4, characterised in that the regenerator comprises a heat exchanger to control the temperature of the energy carrier in the reactor by steam generation in the heat exchanger.

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6.

The thermodynamic process in accordance with any of claims 1, 3, 4 and 5, characterised in that regenerated energy carrier is transported pneumatically, i.e. without gravitational fall, through the riser by all, or a part of, the stream of combustion gases.

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7.

The thermodynamic process in accordance with any of the preceding claims, characterised in that the coke which is oxidized on the energy carrier substantially supplies the energy for the operation of the process.

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8.

The thermodynamic process in accordance with any of the preceding claims characterised in that the product gases are passed to a suitable condensing system consisting of an oil- or steam condenser or a distillation column.

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9.

The thermodynamic process in accordance with any of the preceding claims, characterised in that the feed oil is preheated by the heat of condensation of the gases and that the oil is atomized in a nozzle having a central inlet for steam, whereby the pressure is preset by springs and the oil in the surrounding chamber is passed to a ring slot where steam hits the oil film and breaks it up into droplets.

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10.

A thermodynamic cracking unit, characterised in that it comprises a cyclon reactor and a riser of varying diameter, whereby the inlet of the cyclone reactor is provided in the lower part of the reactor, in order to bring the particles into an upward circulating

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movement with large shear and centrifugational forces, a perforated fluidizing plate situated approximately half a diameter from the bottom of the regenerator over a plenum for the regeneration of the energy carrier, as well as a heat exchanger, provided in the fluidized bed of the particles in the regenerator, in order to control the temperature.

5 11.

The thermodynamic cracking unit in accordance with claim 10, characterised in that the varying diameter of the riser leads to acceleration and retardation of the stream of gas and particulate energy carriers leading to velocity variations between the gas and the particles and thereby an optimization of the collisions between the particles and the oil drops injected in the riser and thereby optimization of the energy transfer and mechanical collision forces between the particles and the oil droplets.

15 12.

The thermodynamic cracking unit in accordance with claim 11, characterised in that the colliding particles in the riser of varying diameter leads to sonoluminescence caused by the fact that gas trapped in cavities on the particles and between these are exposed to adiabatic compression whereby temperature and pressure of the gas bubbles are increased and sonoluminescence is created by splitting of the molecules in the gas, which can be oil gas or steam, and emits light and by the fact that part of the oxygen radicals binds to the splitted oil molecules and thereby results in hydrogenation of the oil.

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